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PHYSICS.—*Note on graphic solutions of Wien's spectral equation.* GEORGE K. BURGESS, Bureau of Standards.

The fundamental equation of optical pyrometry is that expressing Wien's law,

$$I_\lambda = C\lambda^{-5}\, e^{-c/\lambda T}$$

which we may consider from three points of view:

1. For the determination of the temperature T_1 or T_2 of a black body from observations on the corresponding intensities I_1 and I_2 of light of a given wave length:

$$\frac{\lambda}{c}\, ln\, \frac{I_1}{I_2} = \frac{1}{T_2} - \frac{1}{T_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

2. For the determination of the temperature T of a substance whose absorption coefficient A_λ (equal to $1 - R_\lambda$ where R_λ is the reflecting power) for a given wave length λ is known and whose apparent temperature is S_λ as given by an optical pyrometer using light of the same wave length λ :

$$\frac{\lambda}{c}\, ln\, A_\lambda = \frac{1}{T} - \frac{1}{S_\lambda} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

3. For the determination of the temperature of a black body from intensity observations at two wave lengths λ_1 and λ_2:

$$ln\, \frac{I_1}{I_2} = 5\, ln\, \frac{\lambda_2}{\lambda_1} + \frac{c}{T}\left(\frac{1}{\lambda_2} - \frac{1}{\lambda_1}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The value of c is a constant that has been determined as lying

between 14200 and 14700 when λ is expressed in μ (0.001 mm.) and temperatures in centigrade absolute.

Equations (1) and (2) are identical in form and may be treated together. Equation (3) is of only limited interest in temperature

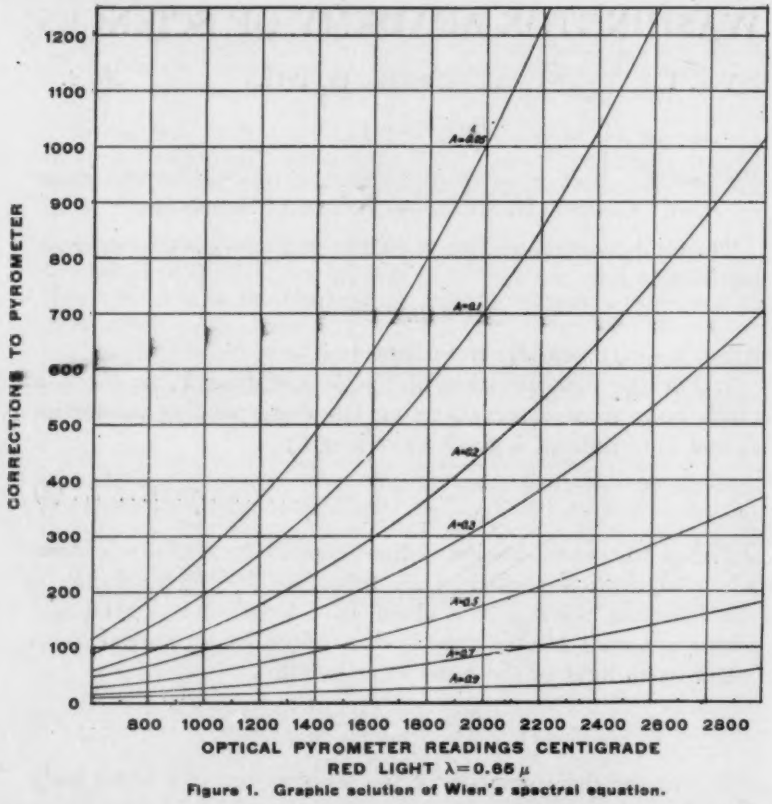

Figure 1. Graphic solution of Wien's spectral equation.

measurements,[1] and may be treated graphically by plotting I_1/I_2 against T for the wave lengths used.

[1] Thürmel, Ann. der Phys., 33: 1139–1160. 1910. Wilsing and Schemer, Pub. Astrophys. Obs. Potsdam, No. 56, 19.

A graphic solution of (2) suggested by v. Wartenberg[2] is to plot the curves S = constant with values of A as ordinates and of T–S as abscissae.

In view of the fact that for any given substance the value of A_λ, in general, remains constant, it seems to us most convenient for the estimation of temperatures, of the several possible graphic methods, to plot the curves, A_λ = constant, with the values of the pyrometer reading $S_\lambda - 273$ as abscissae and the correction $T - S$ as ordinates or its equal: $t - (S_\lambda - 273)$, where t is temperature centigrade. Such a plot is shown in figure 1 for a pyrometer using red light of $\lambda = 0.65\mu$ and for the value $c = 14500$.

The same plot serves also for equation (1) for passing from one known temperature to another, unknown, when sighting on a black body. In this case the ratio I_1/I_2 is usually given directly from a known relation of scale reading to intensity for the pyrometer used. When a considerable number of observations is to be taken, it is worth while to construct such a plot for the wavelength used.

Pirani[3] uses a protractor method for the solution of (2) by means of which a straight edge laid across the paper gives the value of T by intersecting the values of S and A.

Pirani also, but it would appear incorrectly, gives a similar graphical method for passing from the value of $A_{\lambda 1}$ to $A_{\lambda 2}$, or from the absorption coefficient as measured in terms of one wave length to that of another. He appears to assume that

$$\frac{\lambda_1}{c} ln\, A_{\lambda_1} \qquad \text{is equal to} \qquad \frac{\lambda_2}{c} ln\, A_{\lambda_2}$$

which is true, however, only in special cases (*i.e.*, when $S_{\lambda 1} = S_{\lambda 2}$), as for instance the limiting case in which $T = S_\lambda$ (equation 2), or for a black body, and is therefore of no interest in the general case for substances possessing values of A differing from unity,

[2] Über optische Temperaturmessungen blanker Körper. Verh. Phys. Ges., 12: 121–127. 1910.

[3] Über zwei Rechentafeln zum Gebrauch bei optischpyrometrischen Messungen. Verh. Phys. Ges., 12: 1054–1058. 1910.

since S_λ and therefore $\frac{1}{T} - \frac{1}{S_\lambda}$ is a variable, depending on the specific emissive properties of the substance.[4] Applied for example, to the computation of the absorption coefficient of liquid copper[5] for green light, assuming that the value of A for red is 0.15, Pirani's method gives an absurd result, *i.e.*, 0.06 instead of 0.35 for $A_{.55}$.

It would lessen indefinitely the number of necessary observations if, in the general case, it were possible to compute the absorption coefficient for any wave length when that for one wave length is known. No such mathematical relation exists, however. Similarly, it is impossible either mathematically or graphically to find an exact, general relation between the true temperature of a substance and the apparent temperatures given by observations with light of two or more wave lengths except in terms of the absorption coefficients, $A_{\lambda 1}$ and $A_{\lambda 2}$, when equation (3) takes the form

$$ln\frac{I_1}{I_2} = 5ln\frac{\lambda_2}{\lambda_1} + \frac{c}{T}\left(\frac{1}{\lambda_2} - \frac{1}{\lambda_1}\right) + ln\frac{A_{\lambda_1}}{A_{\lambda_2}}$$

in which the observed ratio I_1/I_2 is corrected for the sensibility of the eye. This equation may be solved graphically, among other ways, by plotting lines of $A_{\lambda 1}/A^{\lambda}_{2}$ = constant with values of I_1/I_2 or its logarithm as abscissae and of T or t, or their reciprocals as ordinates. There are, however, in certain cases, some of the metals for instance, convenient, simple empirical approximations connecting apparent temperatures with true, which may be expressed graphically.[6] Although it is impossible graphically or otherwise, to pass from one value A_{λ_1} to another A_{λ_2} unless the energy curve of the substance is known for these regions, yet it is possible to use equation (2) for the comparison of results of observers who have used different values of c.

[4] Holborn and Henning, Sitzber. Berlin Akad., 12: 311. 1905. G. K. Burgess, Bull. Bur. Standards, 1: 443–447. 1905.

[5] G. K. Burgess, Bull. Bur. Standards, 6: 111–119. 1909.

[6] Waidner and Burgess, Bull. Soc. Franç. de Phys., 200–204. 1907. Jour. de Phys., October, 1907.

In this case we may write, with Pirani,

$$a \log A = \log A' \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

where $a = c/c'$, since c, unlike S or A, is independent of all the other quantities in equation (2). Equation (4) can be plotted in several ways, and permits a ready comparison of the otherwise somewhat contradictory results on the absorption coefficient of the same substance.

MINERALOGY.—*The chemical composition of nephelite.* WALDEMAR T. SCHALLER, Geological Survey.

The chemical composition of nephelite has long been a much discussed problem among mineralogists. One general theory endeavors to harmonize the analytical figures with the calculated values by the assumption of a number of complex formulas. The very complexity of these formulas is sufficient to cast doubts on their correctness. Another view is that the groups (SiO_4) and (Si_3O_8) can replace each other, in an isomorphous sense, so that by the presence of sufficient (Si_3O_8) replacing (SiO_4), the analytical figures obtained can readily be accounted for. Foote and Bradley have recently proposed[1] still another explanation, namely that as a substance on crystallizing may form a "solid homogeneous solution with foreign matter . . . ", the mineral nephelite consists of a pure compound, probably $NaAlSiO_4$, with a varying amount of dissolved silica. Such an interpretation certainly is suggestive but before it can be accepted for the case of nephelite it must be proved that the compound $NaAlSiO_4$ can dissolve silica. Furthermore, the fact that chemically the "dissolved silica" acts in an entirely different way from any known modification of silica must be satisfactorily accounted for.

I believe that the composition of nephelite can be readily explained without assuming complex formulas and without calling on the hypothesis of "dissolved silica." The mineral albite has the formula $AlNaSi_3O_8$ and the corresponding isomorphous mineral anorthite has the formula $AlCa_{\frac{1}{2}}SiO_4$. The soda anorthite,

[1] Foote, H. W., and Bradley, W. M.: On solid solution in minerals with special reference to nephelite. Amer. Jour. Sci., 4th ser., 31: 25. 1911.

$AlNaSiO_4$, has been prepared artificially, and Washington and Wright have assumed[2] its presence to the extent of 5.58 per cent in a feldspar (anemousite) consisting essentially of albite and anorthite in isomorphous mixture.

We have, in the feldspars just named, two types of compounds, $AlR'SiO_4$ and $AlR'Si_2O_8$, and their isomorphous relation, as earlier developed by Clarke (Bull. 125, U. S. Geol. Survey) lead to a simple interpretation of the composition of nephelite. These compounds occur in several modifications, which are isomorphous. This relation can be best shown schematically.

MODIFICATIONS OF COMPOUNDS $AlR'SiO_4$ AND $AlR'Si_2O_8$

COMPOUND	HEXAGONAL	MONOCLINIC	TRICLINIC
$AlNaSiO_4$	Essential component of nephelite; artificially prepared		Artificially prepared; naturally only in mixture (carnegieite)
$AlKSiO_4$	Kaliophilite		
$AlCa_{\frac{1}{2}}SiO_4$	Present in small amounts in the calcic varieties of nephelite	Celsian is the corresponding barium salt	Anorthite
$AlNaSi_2O_8$	Naturally only in mixture in nephelite	Barbierite	Albite
$AlKSi_2O_8$		Orthoclase	Microcline
$AlCa_{\frac{1}{2}}Si_2O_8$			

The mineral nephelite is then an isomorphous mixture of the compounds crystallizing in the hexagonal modification, which are:

$AlNaSiO_4$—essential component
$AlKSiO_4$—kaliophilite
$AlNaSi_2O_8$—best known in its triclinic form as albite.

To show that the explanation offered is in agreement with the analyses of nephelite it will suffice to quote two analyses, the first

[2] Washington, H. S., and Wright, F. E.: A feldspar from Linosa and the existence of soda anorthite (Carnegieite). Amer. Jour. Sci., 29: 52. 1910.

one by Foote and Bradley and the second one by Morozewicz (No. V—reference given in paper of Foote and Bradley). These have been chosen as they are among the best analyses and show a minimum amount of other bases such as CaO, Fe_2O_3, etc.

The nephelite analyzed by Foote and Bradley consists, as calculated from their ratios, of the following compounds in the proportions indicated.

Composition of nephelite (Foote and Bradley)

60 parts or 19.0 per cent of $KAlSiO_4$
245 parts or 70.4 per cent of $NaAlSiO_4$
21 parts or 10.6 per cent of $NaAlSi_2O_8$.

The comparison of the analysis with the figures calculated from the above composition is very close, as is shown below.

COMPARISON OF ANALYSIS WITH CALCULATED VALUES

	ANALYSIS	CALCULATED
SiO_2	44.46	44.45
Al_2O_3	33.11	33.37
Fe_2O_3	0.96	
K_2O	5.61	5.66
Na_2O	16.32	16.52
H_2O	0.38	
	100.84	100.00

Analyses No. V of Morozewicz yields the following composition:

Composition of nephelite (No. V Morozewicz)

62 parts or 19.7 per cent of $KAlSiO_4$
259 parts or 74.7 per cent of $NaAlSiO_4$
11 parts or 5.6 per cent of $NaAlSi_2O_8$.

As in the other case, the comparison of the analysis with the values calculated from the above composition, shows a very close agreement.

COMPARISON OF ANALYSIS WITH CALCULATED VALUES

	ANALYSIS	CALCULATED
SiO_2	42.71	43.04
TiO_2	0.04	
Al_2O_3	33.83	34.20
Fe_2O_3	0.40	
K_2O	5.86	5.89
CaO	0.32	16.87
Na_2O	16.46	
H_2O	0.18	
Imp.	0.06	
	99.86	100.00

The figures prove, I believe, that the composition of the mineral nephelite can be solved by the explanation herein offered which rests primarily on the isomorphous relation of (SiO_4) and (Si_3O_8).

The remarkable fact that the compound $KAlSiO_4$ is always present in nephelite to the extent of about 20 per cent has as yet not received any adequate explanation.

MINERALOGY.—*The alunite—beudantite group.* WALDEMAR T. SCHALLER, Geological Survey. To appear in the American Journal of Science.

A consideration of the various possible members of the alunite—beudantite group has led to some interesting results for fuller description of which reference must be made to the complete paper. Hamlinite is doubtless identical with goyazite; utahite, cyprusite, raimondite, pastreite, carphosiderite and apatelite are probably all the same mineral with the formula $H_2O.3Fe_2O_3.4SO_3.6H_2O$; and the probable compositions of pharmacosiderite and harttite are suggested. All of the minerals of these groups have very similar crystallographical and optical properties. Their formulas may be so written as to clearly bring out their close chemical relationship. The minerals may be placed into three sub-groups which are: sulphates, phosphates, and sulphate-phosphates respectively; the general formula for each of these sub-

groups being as follows: Sulphates $[R'''(OH)_2]_6.R''.[SO_4]_2.[SO_4]_2$, Phosphates, $[R'''(OH)_2]_6.R''.[HPO_4]_2.[R''(PO_4)_2]$ and Phosphate-sulphates $[R'''(OH)_2]_6.R''.[SO_4]_2.[R''(PO_4)_2]$. In the sulphate sub-group, R'_2 replaces R'' in most cases or else two univalent alkali metals, such as (K_2) may be considered equivalent to R''. Of the acid radicles the bivalent group $=[SO_4]_2$ is considered as isomorphous with the bivalent group $=[HPO_4]$.

MINERALOGY.—*The relations of purpurite and heterosite.* WALDEMAR T. SCHALLER. To appear in Bulletin 490, U. S. Geological Survey.

The mineral purpurite, a hydrous manganic ferric phosphate, $(Mn, Fe)_2O_3.P_2O_5.H_2O$, was first found in North Carolina, by L. C. Graton, and a description of it was published[1] in 1905.

Since the original discovery the same mineral has been found at other localities[2] (South Dakota, Connecticut). Lacroix,[3] to whom some of the original purpurite from North Carolina was sent, has stated that purpurite is identical with heterosite. In view of this I propose that the name heterosite be restricted to the ferric phosphate and the name purpurite to the manganic phosphate. Heterosite predominates (76 per cent) in the material from South Dakota while purpurite predominates (65 per cent) in that from North Carolina. More accurately the North Carolina material should be called iron (or ferric) purpurite and that from South Dakota and from France, manganese (or manganic) heterosite.

In the original paper describing purpurite the suggestion was made that the pure end members could be called ferripurpurite and manganipurpurite. Since, however, the identity of the mineral with the French heterosite has been advocated by Lacroix, the names ferripurpurite and manganipurpurite should be replaced by the older names heterosite and purpurite respectively.

[1] Graton, L. C., and Schaller, W. T.: Purpurite, a new mineral. Am. Jour. Sci., 4th ser., **20**: 146. 1905.

[2] Schaller, W. T.: Mineralogical Notes,—1. Purpurite from two new localities. Am. Jour. Sci., **24**: 152. 1907.

[3] Lacroix, A.: Minéralogie de la France, **4**; 469. 1910.

MINERALOGY.—*Note on barbierite, monoclinic soda feldspar.* WALDEMAR T. SCHALLER To appear in a bulletin, "Mineralogical notes, Series II" of the U. S. Geological Survey.

In a recent paper[1] I proposed the name barbierite for the monoclinic soda feldspar isomorphous with orthoclase. A feldspar from Kragerö, Norway, analyzed by Barbier and Prost[2] is nearly pure barbierite, as only 1.15 per cent K_2O was found.

Professor Barbier was kind enough to send me some slides of the feldspar from Kragerö which, according to his analysis, consists essentially of the soda compound. One of the slides, a basal section giving parallel extinction and appearing uniform, was uncovered and the feldspar washed free from Canada balsam. The mineral was then immersed in an oil with refractive index of 1.530 and it was seen that the index of the mineral was considerably lower than that of the oil. If the orientation of the mineral is the same as that of orthoclase then a basal section would yield values for α and for γ. As these were both found to be decidedly lower than 1.530, the section cannot be albite[3]. Unfortunately the very small section was accidentally lost before its soda content could be verified microchemically. The existence of a monoclinic form of the compound $Al_2O_3.Na_2O.6SiO_2$, different from albite, is therefore established.

PETROLOGY.—*Note on some albitite dikes in Nevada.* FREDERICK LESLIE RANSOME, Geological Survey.

The dikes here described occur in the southeast corner of Humboldt County, about thirty miles east-southeast of Lovelock, in that part of the Pahute Range that is locally known as the Stillwater, Silver, or Table Mountain, Range. They are associated with the nickel deposits of Cottonwood Canyon[4] and are intrusive as rather short irregular bodies into andesite and diorite.

[1] Amer. Jour. Sci., 4th ser., 30: 358. 1910.

[2] Bull. Soc. Chim., III, p. 894. 1908.

[3] For albite, $\alpha = 1.529$, $\gamma = 1.539$.

[4] Ransome, F. L.: Notes on some mining districts in Humboldt County, Nevada. Bull. U. S. Geol. Survey No. 414, pp. 55–58. 1909.

The rock is of almost snowy whiteness and consists chiefly of striated feldspar with minute, dark, disseminated crystals whose form and luster as seen under a hand lens are at once suggestive of anatase or rutile. The general texture of the rock is equigranular, the average diameter of the grains being 5 mm. or less.

In thin section under the microscope the rock appears as essentially an aggregate of subhedral and much-twinned plagioclase. Some of the angular spaces between the feldspar are filled with clear calcite, others with a fine-grained, foliated aggregate consisting chiefly of kaolinite, and still others with quartz.

The feldspar, which is generally fresh, has a refractive index of about 1.54, a birefringence equal to or lower than the quartz in the same section, an extinction angle on (001) of about 4° and an observed maximum extinction in the zone normal to (010) of 19°. It thus belongs at the albite end of the plagioclase series although it contains a small proportion of the anorthite molecule. The twinning lamellæ according to the albite and pericline laws, are generally thin, irregular and discontinuous, so that some of the crystals as seen in thin section have almost the plaid-like appearance of microcline. Carlsbad twins are rare and the crystals are not noticeably zoned.

The calcite areas as seen under the microscope are bounded in part by the crystallographic outlines of the albite and in part penetrate the contiguous fresh feldspar in a manner indicative of replacement. Without much doubt the calcite is secondary although it does not appear to have been formed by the local decomposition of feldspar but rather to have been introduced by solutions into miarolitic cavities which to some extent have been enlarged by metasomatism. The similarly interstitial kaolinite likewise shows no evidence of being a product of decomposition *in situ* and the adjacent feldspar is not kaolinized. The kaolinite also may have been carried into small cavities by infiltration. Finally, the quartz, which is not a conspicuous constituent and is not distinguishable at a glance from such sections of albite as show no twinning, may in part be of secondary introduction; for some of it displays the shadowy extinction and the suggestion of plumose structure that are specially characteristic of quartz deposited in veins.

The mineral noted as occurring in small glittering specks does not give any clear indication of its crystal form in thin section; but particles obtained by crushing the rock and concentrating the powder by panning, when examined under the microscope, show that the mineral has at least one perfect cleavage, that its luster is metallic-adamantine and that it crystallizes for the most part in acute, distorted, tetragonal pyramids, apparently the unit form, with strong transverse striations. A few, more regular forms were also observed in which the striations are limited to the equatorial zone of the crystal. The color by transmitted light is yellow to chestnut brown, with notable absorption in directions transverse to the prism axis. The index of refraction is high and the birefringence strong. Particles tested chemically by Mr. W. T. Schaller gave a strong reaction for titanium, which, with such crystallographic and optical data as have been recorded leaves little doubt of the identity of the mineral as anatase The crystals, none of which is over a millimeter in length, occur embedded in all of the other constituents of the rock save apatite and zircon, which are the other accessory minerals present. With the apatite, moreover, it appears to have projected into the cavities now occupied by calcite.

Anatase is not a common rock constituent, and, where present, has generally been considered as a product of alteration. In these dikes, however, the mineral is apparently original for altho many of the crystals are enclosed in calcite others are embedded in fresh albite and in quartz.

A chemical analysis of a specimen of rock from one of the dikes near the nickel mine in Cottonwood Canyon is as follows:

Chemical analysis of albitite

George Steiger, analyst

SiO_2	61.71	H_2O-	0.51
Al_2O_3	16.63	H_2O+	0.81
Fe_2O_3, FeO	0.40	TiO_2	0.79
		ZrO_2	0.04
MgO	none	CaO_2	4.05
CaO	5.94	P_2O_5	0.15
Na_2O	8.52		
K_2O	0.16		99.71

The mineralogical composition as calculated from this analysis in accord with the microscopical examination, the small quantity of potash being included in the albite, is as follows:

Albite (approx. Ab_{96} An_4)	76.5
Calcite	9.2
Quartz	8.8
Kaolinite	3.5
Anatase	0.8
Apatite	0.4
Water	0.8
	100.0

The calculation of the norm in order to find the place of the rock in the American quantitative system presents some difficulties, owing to the presence of the calcite. If the calcite were calculated as such it would place the rock with beerbachose in the dosalane class, where it evidently does not belong. If the carbon dioxide be disregarded and the analysis recalculated to 100, the derived norm shows an excess of calcium in the form of over 9 per cent of calcium metasilicate. In other words there is not enough alumina to combine with all of the alkalies and lime as feldspar. The norm on this basis falls in the unnamed persodic subrang of the alkalicalcic rang of the canadare order of the persalane class. On the other hand if both the carbon dioxide and the calcium oxide be rejected, the analysis recalculated to 100, and the norm then computed, the rock falls into the subrang tuolumnose in company with the somewhat similar soda-syenite porphyry of Tuolumne County, California, described by Turner[2] and the soda syenite or albite diorite[3] of Douglas Island, Alaska. This appears to be its natural association and the tentative calculation of the three norms, by showing that the lime is in excess of the quantity that can be combined with the available alumina to form feldspar, indicates either that the calcite is an original mineral (which the microscope disproves) or that the calcite has been

[2] Turner, H. W.: Further contributions to the geology of the Sierra Nevada, 17th Ann. Rept. U. S. Geol. Survey, Part I, p. 665. 1896.

[3] Spencer, A. C.: The Juneau gold belt, Alaska. Bull. U. S. Geol. Survey No. 287, pp. 99–105. 1906.

introduced into the rock and is not an ordinary decomposition product.

The known representatives of the subrang tuolumnose are not numerous, there being only three listed in Washington's tables,[4] of which one, the albite diorite of Douglas Island, is considerably altered. This fact and the presence of anatase in the Nevada rock are thought to warrant the publication of this brief petrographic note.

BOTANY.—*The genus Annona: the derivation of its name and its taxonomic subdivisions.* W. E. SAFFORD, Bureau of Plant Industry.

The genus Annona, which includes the custard apple (*Annona reticulata*) and the soursop (*Annona muricata*), was described by Plumier (1703) under the name of Guanabanus, which he adopted from *guanabano*, the vernacular name of one of the species on the island of Santo Domingo, published by Oviedo in his account of the fruit trees of the New World (1535).

Linnæus was at first inclined to accept as the name of this genus *Anona*, from the vernacular name *anon*, or *hanon*, applied to another species, and used by various early authors; but in his *Hortus Cliffortianus* (1737) he rejects both *Guanabanus* and *Anona*, as barbarous words, and substitutes for them the classic Latin *Annona*. This name, signifying "the year's harvest" of fruit, wine, etc., he thought particularly applicable, on account of the edible fruit of the Annona, which is relished by the natives of the countries where it grows.[1] This was in accordance with the principal of rejecting barbarous names, which he afterwards defended in his *Philosophie Botanique* (1788)[2].

[4] Washington, H. S.: Chemical analyses of igneous rocks. Profess. Paper, U. S. Geol. Survey No. 14, p. 199. 1903.

[1] "Guanabanus et Anona sunt vocabula barbara, ut tamen servetur sonus Annonam dico ob fructum incolis gratum."—Linnæus, Hort. Cliff. 222. 1737.

[2] "Nous adoptons *comme nouveaux tels* des noms Barbares, auxquels nous avions donné l'exclusion, lorsque nous rendons nouveaux des noms à exclure, en les formant du Grec ou du Latin . . . . *Corossol*, Annona (Anona des Américains), de la moisson."—Linnæus, Phil. Bot. 208. 1788.

Annona then, and not *Anona*, must be the name used for the genus. It was published in the first edition of the Species Plantarum (1753), from which modern binomial nomenclature takes its origin; and it is equivalent to Plumier's genus *Guanabanus*, as stated by Linnæus in his Genera Plantarum (1754). He changes the name to Annona, and typifies the genus by the species *Annona muricata*, Plumier's "Guanabanus fructu e viride lutescente molliter aculeato."[3]

The name of the family must also preserve its original form *Annonaceae*, as published by Richard in 1808; not "Anonaceae," as published by Dunal in 1817, and by DeCandolle in 1818.[4]

The genus is naturally divided into several sections owing to the diversity in the form of the flowers. The subdivisions generally accepted heretofore have been: *Guanabani* (Plumier), including *Annona muricata* and its allies; *Attæ* (Martius), including *Annona squamosa* and its allies; and *Anonellæ* (Baillon), based upon *Annona globiflora*, a dwarf shrubby plant of eastern Mexico.

The discovery of new species with characters quite distinct from any of those included in the above sections has made an additional subdivision necessary, based upon *Annona macroprophyllata* the most striking peculiarity of which is the presence of broad persistent leaf-like bracts at the base of the peduncle. In conforming with modern botanical usage the author proposes the following names for the subdivisions of the genus.

Section I. **Euannona** (Type, *Annona muricata*).—In this section the flowers have a corolla composed of 6 broadly ovate or orbicular concave petals in two series, the 3 outer ones thick and leathery and more or less cordate at the base, the 3 inner ones somewhat smaller and thinner but conspicuous. Here are placed *Annona muricata*, the soursop, which is the type of the genus Annona; *Annona montana*, the wild soursop of the West Indies; *Annona glabra*, the alligator apple of mangrove swamps; *Annona purpurea*, the soncoya of southern Mexico and Central America; and *Annona uncinata*, an undescribed species from the *tierra caliente* of Mexico.

[3] Linnæus Sp. Pl. 536. 1753.—Gen. Pl. 241. 1754.

[4] Richard, Demonstr. Bot. ou Analyse du Fruit, 17. 1808.

SECTION II. **Atta** (Type *Annona squamosa*).—In this section the corolla is composed of 3 narrow, oblong or lanceolate petals, never opening to the base, or if there are 6 petals the inner ones are reduced to small scales. The peduncles are usually nodding or reflexed and are devoid of leaf-like bracts. Here are placed *Annona cherimolia* and the closely allied *Annona longiflora*, both of which have velvety leaves and delicious fruit called chirimoya; *Annona squamosa*, the sugar apple, atta, or pomme cannelle; *Annona reticulata*, the common custard apple, or "bullock's heart;" and *Annona scleroderma*, a new custard apple from Guatemala.

SECTION III. **Ilama** (Type, *Annona macroprophyllata*).—In this section the peduncles are remarkable for a pair of orbicular or oval persistent leaf-like bracts at their base. The corolla is composed of 3 oblong or linear petals swollen at the base and opening widely when the flower is mature. Here are placed *Annona macroprophyllata* and the closely allied *Annona diversifolia*, a new species from Colima. The name *Ilama* proposed by the writer for this section is a vernacular name of Aztec origin applied to the fruit of the latter species at Colima.

SECTION IV. **Annonella** (Type, *Annona globiflora*).—In this section are included dwarf shrubby species, with very small 3-petaled flowers and small net-veined leaves resembling those of certain species of Rollinia rather than the typical feather-veined leaves of the genus Annona. Here are placed *Annona globiflora* of eastern Mexico, the peculiar appearance and habit of which suggests to Baillon the creation of a separate section of the genus to include it, and *Annona palmeri*, a closely allied new species from the *tierra caliente* of western Mexico. In both of these species the fruit is about the size of a small peach, with little pulp surrounding the comparatively large yellowish Rollinia-like seeds.

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

ELECTRICITY.—*Copper wire tables.* Circular Bureau of Standards No. 32. 1911.

This circular was prepared at the request of the Standards Committee of the American Institute of Electrical Engineers. In its preparation the Bureau has had the coöperation of that Committee and the tables have been adopted as official by the Institute.

The circular discusses the results of work recently completed at the Bureau on the temperature coefficient and the conductivity of copper, as well as previous standard values, and gives a history of wire gages, showing that the trend of practice is toward expressing diameter directly in decimal fractions of an inch.

There are fifteen tables including complete reference tables for standard annealed copper, American Wire Gage, both in English and in metric units; and similar abbreviated "working tables." There are also tables for bare concentric cables of standard annealed copper and for hard-drawn aluminum wire. The tables also include comparisons of wire gages, and tables of temperature reductions, with complete explanations.

Four appendixes give additional information—the first on the units used in the expression of resistivity; the second on the calculation of the "resistivity-temperature constant" and on the expression of the temperature coefficient; the third on the density of copper; and the fourth on the calculation of the resistance and mass per unit length of cables.

J. H. DELLINGER.

AGRICULTURAL PHYSICS.—*Studies in soil physics.* E. E. FREE. Plant World, **14**: Nos. 2, 3, 5, 7 and 8. 1911.

These five articles present briefly and in a non-technical way the author's point of view toward certain of the more salient points of soil

physics. Conceptions useful to the plant physiologist or ecologist are especially emphasized. The titles and main conclusions of the individual papers are as follows: (1) *The physical condition of soils.*—The range of physical conditions possible to a soil is determined by its ultimate physical nature or character, that is by the nature, size, and number of the particles of which it is composed. The physical condition, within this fixed range, is controlled by the moisture content by virtue of the surface tension on the water films between the soil grains. (2) *Movements of soil water.*—The capillary actions in the soil are controlled by the forces of surface tension on the water films. Permeability is a matter of the size of the individual interspaces of the soil, not of their total amount. (3) *Soil water and the plant.*—A very important but much neglected factor in the movement of water from soil to plant and through the plant is the evaporating power of the air. (4) *Physical constants of the soil.*—A critical examination of the various measurements which have been proposed as characteristic soil constants shows that all are in some degree unsatisfactory. The mechanical analysis in particular, is much less adequate than is usually believed. It is probable that another and better constant can be developed out of the water equivalent and the critical moisture content. (5) *Soil temperatures.*—The main effect of the soil character upon its temperature is due to its water capacity. The wetter soil warms and cools more slowly. E. E. F.

ANALYTIC CHEMISTRY.—*The determination of sugars in grain and cattlefoods.* A. HUGH BRYAN, A. GIVEN and M. N. STRAUGHN. Circular 71, Bureau of Chemistry.

The determination of sugars in vegetable materials, either fresh or dried, having large quantities of starch, gums, fiber, etc., presents many difficulties. Methods for such determinations are few and in most cases are not explicit.

Extraction with hot water dissolves the sugars but also gelatinizes the starch and therefore produces changes in the sugar content, while cold water extraction causes the enzymes if present to become active and hence to change the sugar content during extraction. To inhibit the enzyme action alkalies are often added and the extraction carried on in the cold. A comparison of a method based on this procedure and of a method of extraction using 50 per cent alcohol has been made and as a result it is shown that with some substances the two methods give concordant results but the alkaline water extraction method is

open to many chances of error, viz., acidity of sample, fineness of sample and time of digestion, changes in sugar content after neutralizing the alkalinity, etc. These are separately treated.

The method proposed for extraction with the least chances of error is: Boil 12 grams of the finely ground material in a 300 cc. flask with 150 cc. of 50 per cent alcohol neutral in reaction for one hour, using a reflux condenser. Complete the volume to 300 cc., after cooling, with 95 per cent alcohol. Transfer 200 cc. to a beaker with a pipette and evaporate on a steam bath to 20 or 30 cc. Transfer this to a 100 cc. flask with water, clarify with a solution of neutral lead acetate, make to volume and filter. Remove the excess of lead, which should be very small, with anhydrous sodium carbonate, filter and determine the reducing sugars in an aliquot portion by one of the usual methods. Invert another portion with acid or invertase for the determination of total sugars.

For accurate work the volume occupied by the original substance must be taken into account. An average for a number of determinations shows that 12 grams of such material occupy about 12 cc. and hence the factor of 0.97 must be applied to the results. It is not well to weigh the precipitated cuprous oxide as such as this is often contaminated with nitrogenous bodies and also mineral matter, but the copper should be determined in it by some such method as Low's. Results are best reported as "Reducing sugars calculated as invert sugar" or "Reducing sugars calculated as dextrose" and "Total sugars by acid inversion calculated as dextrose (or invert sugar, as the case may be)" or "Total sugars by invertase calculated as dextrose (or invert sugar, as the case may be)."

If sucrose is calculated, it should bear some such wording as "Sucrose calculated from increase of sugars by acid inversion" or "Sucrose calculated from increase of sugars by invertase inversion." A. H. B.

AGRICULTURAL CHEMISTRY.—*Translocation of plant food and elaboration of plant material in wheat seedlings.* J. A. LeClerc and J. F. Breazeale. Bulletin Bureau of Chemistry No. 138. 1911.

Wheat was sprinkled upon thin perforated discs of aluminum and placed in pans of water to sprout. Samples of 100 to 200 were withdrawn at regular intervals, the plumule and radicle separated from the rest of the seed and analyses made of both portions. In this way the movement of the organic and inorganic salts from the bran and endo-

sperm into the plantlet was determined. The most noticeable feature of this movement was the action of the potassium. When the seedling was only two days old and weighed only about 6 per cent as much as the whole seed, it had absorbed about 50 per cent of the potash of the original seed as compared with 25 per cent of the nitrogen and 17 per cent of the phosphoric acid. Practically all of the salts were found to be absorbed at the end of the seventeenth day. Evidently there is no exchange of fat from the bran and endosperm into the plantlet. The amount of sugar both in the plantlet and in the residual seed reaches a maximum at about the seventh day and decreases rapidly from that time until the seventeenth day when the experiments were discontinued. The pentosans increased steadily throughout this period.

The effect of an outside application of plant food was tried with little effect. The plants were grown in nutrient solutions containing single salts and salts in combination but no appreciable difference could be detected in the movement of the plant foods from the endosperm and bran into the embryo. J. A. B.

AGRICULTURAL CHEMISTRY.—*Methoxyl in soil organic matter.* E. C. SHOREY and E. C. LATHROP. Journal of the American Chemical Society, **33**: 75–78. 1911.

Methoxyl was found (by the Zeisel method) in small amounts in all but 2 of 10 soils widely varying in type and in character of organic matter. Its quantity bore no constant relation to, and is perhaps an unimportant part of the total organic matter of, the soil. It is probably derived from the decay of vegetable matter and its variation in soils of the same type indicates some fundamental difference in the chemical, physical, or biological factors that decide in what way a complex organic compound shall break down or decay when added to a soil. E. C. L.

AGRICULTURAL CHEMISTRY.—*Lawn soils.* OSWALD SCHREINER and J. S. SKINNER. Bulletin Bureau of Soils, No. 75. 1911.

In this bulletin is presented the character of soils in respect to their mineral and organic materials, as well as the kind and amounts of different sized soil particles which determine the suitability of soils for lawn-making. The texture of soils and the relation of surface soil to subsoil receive consideration and the difference is pointed out between land devoted to lawn culture and to a farm crop. The movement of soil moisture, its dependence on texture, and its importance to the main-

tenance of a good greensward are explained. The presence of harmful compounds in certain soils is considered, as is also the influence of trees on lawns.

The best methods of building up grounds artificially by the hauling in of suitable material, both for subsoil fillings and for surface layering, are fully described, a list of soil types adapted to grass growing being given for this purpose.

While the bulletin is mainly for the purpose of aiding in the improvement of large tracts, the individual owner of a small plot in town or city has also been kept in mind. J. S. S.

AGRICULTURAL CHEMISTRY.—*Soil organic matter as material for biochemical investigation.* OSWALD SCHREINER and EDMUND C. SHOREY. Journal of the Franklin Institute, 171: 295. 1911.

Attention is called to the complexity of the organic matter of soils and the fruitful field of research that it offers for biochemical investigation. The importance of the chemical character of the organic matter of the soil is considered under four heads: its effect on crops; its effect on the bacteria and fungi of the soil; its influence on the physical properties of the soil; and its relation chemically to the mineral ingredients of the soil. By the application of the biochemical methods there have been isolated in this research twenty definite organic compounds thus far from that portion of soil organic matter included in the term humus. A chart shows the classification of these compounds, as well as methods of separation. The compounds comprise paraffin hydrocarbons, acids alcohols, esters, carbohydrates, hexone bases, pyrimidine derivatives and purine bases. M. X. SULLIVAN.

AGRICULTURAL CHEMISTRY.—*Studies in soil oxidation.* O. SCHREINER, M. X. SULLIVAN, and F. R. REID. Bulletin Bureau of Soils, No. 73. 1910.

The fact that roots possess the power of reduction is shown by the precipitation of tellurium and selenium from sodium tellurite and selenite, respectively. The oxidative power of the roots is shown by means of organic compounds, which, on oxidation, yield dyes that either color the solution or are deposited on the root surface. These two opposite properties may occur separately or concurrently, depending upon the reaction of the medium. Oxidation within the soil itself is demonstrated by the same reagents as those showing oxidation by the roots. The

reagent most successfully used in the case of soil is aloin, a solution of which in water is changed from yellow to claret red by the oxidation. The depth of color can be measured and indicates the extent of the oxidation.

This oxidation appears to be mainly nonenzymotic, the result of interaction between inorganic constituents and certain types of organic matter. It may also be brought about by organic matter in a state of autoxidation and by inorganic oxygen carriers, such as manganese and iron. Both processes activate oxygen.

The oxidation in soils was increased by the addition of salts of manganese, iron, aluminum, calcium, and magnesium, especially in the presence of simple hydroxyacids, such as citric, tartaric, malic, glycolic, and their salts. The best oxidation was obtained by the addition of manganese, and the stimulating action of manganese used as a fertilizer is attributed to its oxidizing power; i.e., to its amelioration of soil conditions rather than its function as a plant nutrient. Fertilizer salts augment the oxidizing power of roots, and the fertilized soil has an increased oxidizing power after cropping. The fertilizer salts alone sometimes increase, sometimes decrease, the oxidative functions of the soil, thus showing that the fertilizer salts are effecting changes directly or indirectly in the soil constituents more particularly in the organic matter. Some types of organic matter inhibit oxidation but in the main the oxidative power is augmented by a plentiful supply of organic matter, the nature of which in the soil is the limiting factor of oxidation. Excessive oxidation is harmful to vegetation.

Oxidation in soil is parallel to oxidation in plants and animals. Soils oxidize substances in a manner analogous to an oxidase, and the increase noticed by the addition of certain hydroxyacids is closely paralleled by the recently discovered activating action of salts of tartaric and citric acids on the oxidative action of manganese acetate. This analogy between the oxidative power of a soil and the action of an oxidase is especially significant in that an oxidizing enzyme, laccase, of alfalfa, has been found to be more simple in composition than formerly supposed and to consist of neutral salts, mainly calcium, of glycolic, mesoxalic, malic, and citric, and probably glyoxylic acid. It is well known that the oxidase whatever may be their nature, play an important part in the proper functioning of plants, and that with changes in the oxidizing ability are associated changes in plant condition. Similarly, oxidative power of the soil is a symptom of soil condition.

Whatever decreases the oxidation in soils tends also to bring about

the conditions which decrease growth, and the factors which favor oxidation are the factors which favor soil productivity.

O. S., M. X. S., and F. R. R.

AGRICULTURAL CHEMISTRY.—*Enzymotic activities in soils.* Oswald Schreiner and M. X. Sullivan. Science, **33**:339, 1911.

Within the bodies of micro-organisms in plant roots and plant debris, in worms and animalcules, enzymes of various kinds must exist. Evidence of various enzymotic activities, proteolytic, amylolytic, inverting, cytolytic, lipolytic, etc., may be seen in many soils. Starches, sugars, cellulose, fat, and protein are speedily changed or disappear, and in many cases especially of proteins, some of the products of digestion may be found in the soil. As yet no satisfactory means have been obtained of extracting enzymes from soil to any great extent, though in those recently cropped there is some slight evidence of the presence of enzyme-like substances in the glycerine extract of the soil. M. X. S.

AGRICULTURAL CHEMISTRY.—*The chemical nature of soil organic matter.* Oswald Schreiner and Edmund C. Shorey. Bulletin Bureau of Soils, No. 74. 1910.

This bulletin discusses the chemical nature of the organic compounds in the soil, and methods are described by which a number of organic compounds have been isolated from soils. These compounds, 16 in number, are described, the manner in which they have been identified pointed out, the possible sources of the compounds suggested, and their relation to other compounds stated. They belong to eight classes of chemical compounds, some containing carbon and hydrogen only, some containing carbon, hydrogen, and oxygen, and some containing carbon, hydrogen, oxygen, and nitrogen. Paraffin hydrocarbons, acids, alcohol esters, carbohydrates, hexone bases, pyrimidine derivatives, and purine bases are represented. The list of isolated and identified compounds comprises: Hentriacontane, $C_{31}H_{64}$; monohydroxystearic acid, $C_{18}H_{36}O_3$; paraffinic acid, $C_{24}H_{48}O_2$; lignoceric acid, $C_{24}H_{48}O_2$; phytosterol, $C_{26}H_{44}O.H_2O$; pentosan, $C_5H_8O_4$; histidine, $C_6H_9O_2N_3$; arginine, $C_6H_{14}O_2N_4$; cytosine, $C_4H_5ON_3.H_2O$; xanthine, $C_5H_4O_2N_4$; hypoxanthine, $C_5H_4ON_4$; fatty glycerides and several resin acids and esters.

This work shows that the complexity of the organic matter of soils is not so great but that the chemical nature of all of the organic matter of soils can be determined by modern methods. E. C. S.

AGRICULTURAL CHEMISTRY.—*The oxidative and catalytic powers of soils and subsoils.* M. X. SULLIVAN and F. R. REID. Science, **33**: 339. 1911.

Surface soils have the power to oxidize easily oxidizable substances such as aloin, guaiac, pyrogallol, hydroquinone, etc. When ten grams of soil are shaken with 500 cc. of a 0.1 per cent water solution of aloin, the yellow color of the aloin is changed to cherry red. On allowing the soil to settle, the solution can be filtered and the depth of color determined in the colorimeter. Broadly speaking, the oxidative power of the soil is symptomatic of a good soil condition, since soils of good productivity have in general good oxidizing power, while soils of poor productivity have, as a rule, poor oxidizing power. Subsoils have little, if any, action on aloin, though occasionally the oxidizing power of the subsoil may be as great or greater than the corresponding surface soil. The catalytic power of the soil or its capacity for decomposing hydrogen peroxide with the liberation of free oxygen is roughly parallel to the oxidative power, in that soils known to be of good productivity have strong catalytic power, while poor soils have weak catalytic power. The oxidative and catalytic powers of the soil are analogous to these powers in plants and animals and are modified in much the same way. M. X. S.

BIOLOGICAL CHEMISTRY.—*Biological analogies in soil oxidation.* OSWALD SCHREINER and M. X. SULLIVAN. Proceedings of the American Society of Biological Chemists, **2**: 11. 1911. Journal of Biological Chemistry, **9**: XVII. 1911.

The soil is the seat of many biochemical activities that directly or indirectly affect fertility. Many of the processes in the soil are analogous to those occurring in plants and animals. Soils may show fatigue under a one-crop system and under unsanitary conditions may contain material which is retardative of plant growth. Many other compounds, some of which are known to be products of proteolytic digestion, occur in soils. The soil *per se* has oxidizing and catalyzing powers which in cropped soils are due partly to activities of plant roots, but in air-dried soils are due mainly to non-enzymotic soil constituents, inorganic and organic, working separately, conjointly or in reinforcing and activating combinations. The recently discovered activating action of salts or organic hydroxyacids and the discovery that alfalfa laccase is a mixture of salts of organic hydroxyacids have a close counterpart in soil oxidation studies. O. S. and M. X. S.

BIOLOGICAL CHEMISTRY.—*Symptoms shown by plants under the influence of different toxic compounds.* OSWALD SCHREINER. Proceedings of the American Society of Biological Chemists, **2**: 7. 1911. Journal of Biological Chemistry, **9**: XIII. 1911.

Observations made in connection with the effects of different organic substances in modifying the growth of wheat seedlings has shown that toxic substances have a specific effect on certain plant functions. For instance, cumarin-affected plants have characteristic stunted tips and broad, distorted leaves. Vanillin strongly inhibits root growth. Quinone causes a tall and slender growth, with thin, narrow leaves, in strong contrast to the cumarin-affected plants. These various effects of toxic compounds are overcome by entirely different fertilizer combinations, the cumarin effect by phosphates, the vanillin effect by nitrates, the quinone effects by potassium salts. The absorption of salts while the plants are under the infiuence of these toxic compounds is likewise different, thus showing that the effect of the poisons is deep-seated, influencing the entire metabolism of the plants. The changes brought about by etherization and the influence of certain gases in causing the so-called sleeping of carnations and other flowers belong to this class of phenomena.

Previous work with plants and toxic compounds has usually been made without the recognition that plants are affected in a markedly different manner by different poisons. The plant, however, like the animal, shows characteristic symptoms of specific poisons and there is a pharmacology of plants as well as of animals.

That organic substances can cause changes in plant characteristics leads to the suggestion that harmful organic substances in the soil or in the plant may be the cause of some now little understood plant diseases. M. X. SULLIVAN.

GEOLOGY.—*The movement of soil material by wind.* E. E. FREE. With a *Bibliography of eolian geology.* S. C. STUNTZ and E. E. FREE. Bulletin Bureau of Soils, No. 68. Pp. 272. 1911.

This bulletin reviews the geologic actions of the wind with especial reference to its share in the moving of soil materials and in the making and mixing of soils. The phenomena of sand dunes, dust storms, eolian deposits (loess, etc.), blown volcanic dust, etc., are summarized and excessive soil blowing is briefly discussed. The main conclusion is that the wind is of considerable importance as an agent of soil formation and change, in humid as well as in arid regions. The literature of eolian geology is critically summarized and the bibliography of over 2000 titles is believed to be fairly complete. S. C. S. and E. E. F.

GEOLOGY.—*The geology and mineral resources of the Nizina District, Alaska.* F. H. MOFFIT and S. R. CAPPS. Bulletin U. S. Geological Survey, No. 448. Pp. 108, with maps, sections, and views. 1911.

The Nizina district embraces an area of about 300 square miles in the Chitina River valley, on the southeast side of the Wrangell Mountains. The geologic section, from the base up, comprises (1) the Nikolai greenstone, not less than 4000 feet thick, made up of lava flows, (2) the Chitistone limestone, 3000 feet thick, (3) the McCarthy shale, at least 2500 feet thick, and (4) the Kennicott formation, consisting of over 7500 feet of conglomerate, shale, and thin limestone. The Chitistone limestone and the conformably overlying McCarthy shale are Upper Triassic. They rest conformably on the Nikolai greenstone, whose age is not definitely known. The Kennicott formation is Upper Jurassic or possibly Cretaceous and rests on the eroded edges of the three older formations. It is intruded by numerous quartz porphyry dikes, which are rare in the older rocks. These four formations are closely folded, but are not greatly metamorphosed. A large part of the shales, heretofore regarded as Upper Triassic, are shown to be Upper Jurassic.

The Nikolai greenstone is of economic importance as a source of copper. Small bodies of copper ore are widely distributed through it and several large bodies, notably that of the Kennicott-Bonanza mine, are situated in the limestone near its contact with the greenstone. The copper, dissolved by water circulating through the greenstone, was precipitated in shear zones and fracture planes. Chalcopyrite, bornite, and chalcocite are the most important copper minerals. The Bonanza ore body, a large mass of chalcocite, is believed to be a primary deposit.

The placer gold of Dan and Chititu creeks is derived from small quartz veins in the Jurassic shales. These veins are probably related in origin to the numerous porphyry intrusions. Reconcentration of the high bench gravels has produced important stream placers.

Certain trains of rock waste that resemble glaciers in form and in other respects are believed to owe their movement to interstitial ice.

F. H. M.

GEOLOGY.—*Geology and oil resources of the Coalinga district, California.* RALPH ARNOLD and ROBERT ANDERSON. With a report on the *Chemical and physical properties of the oils.* IRVING C. ALLEN. Bulletin of the U. S. Geological Survey No. 398. Pp. 354, with maps, sections and views. 1910. Reprinted 1911.

The Coalinga district is a region of arid hills and mountain ridges bordering the west side of the great interior valley of California. The his-

torical record begins with the Franciscan rocks, marine Jurassic formations, which, probably in late Jurassic time, were extensively intruded by basic igneous rocks. Since then they have repeatedly been exposed to erosion and have furnished materials for some of the Tertiary strata. The lower Cretaceous record is scant, the region having been a land area during much of that period. During the upper Cretaceous on the other hand this region was covered far and wide by the sea and the great mass of conglomerate, sandstone and shale then deposited is in places still represented by a thickness of nearly 10,000 feet. The Tertiary section is especially complete, with a thickness of 13,000 feet of sedimentary strata separable by unconformities into six or seven important formations containing abundant fossils. It shows that this region was land from the beginning of the Tertiary until the commencement of estuarine deposition in the Tejon period. Not long after this, in the late Eocene or Oligocene, came the deposition of a great body of diatomaceous shales, of which a thousand feet are still preserved beneath the important erosional unconformity which separates them from the marine Vaqueros sandstone of the lower Miocene. After the lower Miocene there was again a land interval, followed by submergence beneath the sea in the middle Miocene Santa Margarita period, which in turn was brought to a close by uplift and was succeeded at least locally by an interval of erosion. During the upper Miocene and perhaps also early Pliocene epochs fluctuating littoral marine conditions prevailed, with the resultant deposition of variable sediments that make up the Jacalitos and Etchegoin formations. Part of the Pliocene and probably also the early Quaternary was taken up by the deposition of several thousand feet of freshwater, fluviatile and marine sands, gravels and clays composing the Tulare formation, after which there came one of the principal epochs of orogenic movement to which the Coast Ranges have been subjected, with the consequent uplifting and folding of all the strata that precede in time the later Quaternary valley fillings.

Among the more interesting facts brought out in the study of this region are the following: (1) the upper Cretaceous age of an organic shale formation hitherto thought to be Eocene; (2) the presence of a thick diatomaceous shale formation in the Eocene or Oligocene, and of a similar formation in the middle Miocene—the one earlier and the other later than the well known Monterey shale, with which both had been correlated before; (3) the probable middle Miocene and pre-San Pablo age of the Santa Margarita formation; (4) the Miocene age of the greater part of the Etchegoin formation, hitherto regarded as Pliocene; (5) the unconformities of the Eocene on the Cretaceous, of the Miocene on the

Oligocene or Eocene, and of various parts of the Miocene upon each other; (6) the occurrence of the principal orogenic movements of Cenozoic time in four different periods—at the beginning of the Eocene, in the late Eocene or Oligocene, in the early middle Miocene, and in the late Pliocene or early Quaternary.

The evidence as to the origin of the petroleum from minute marine organisms such as diatoms and foraminifera amounts almost to proof. There are two distinct oils in the Coalinga district, one a paraffin oil that comes from organic shale in the Cretaceous and another an asphalt oil almost certainly derived from the diatomaceous Eocene or Oligocene shale. The presence of oil in association with these shales wherever they are present, and its unfailing absence where they are lacking is the most striking of the facts leading to the conclusion that they were the original source of the oil. R. ANDERSON.

BOTANY.—*Experiments in blueberry culture.* FREDERICK V. COVILLE. Bulletin 193, Bureau of Plant Industry, Department of Agriculture. Pp. 100, pls. 18, figs. 31. 1910.

As a result of four years' experimentation with the swamp or high-bush blueberry (*Vaccinium corymbosum*), sometimes objectionably called huckleberry, it has been found that these plants thrive only in acid soils. They fail to grow satisfactorily in a rich garden soil of the ordinary type, in a soil made sweet by lime, in a thoroly decomposed leafmold such as has a neutral reaction, or in a nutrient solution with alkaline reaction. They require an acid nutrient solution or an acid medium of some sort, thriving especially in bog peat or in the acid leaf litter of sandy pine or oak woods.

This type of upland leaf deposit, in which decomposition is retarded for many years, is regarded as essentially peat and in distinction from bog peat is called upland peat. An upland peat is described as a non-paludose deposit of organic matter, chiefly leaves, in a condition of suspended and imperfect decomposition and still showing its original leaf structure, the suspension of decomposition being due to the development and maintenance of an acid condition which is inimical to the growth of the micro-organisms of decay. The use of the name "leafmold," sometimes applied to this upland peat, should be restricted to the advanced stages in the decomposition of leaves, in which leaf structure has disappeared. Typical leafmold is neutral or alkaline in reaction, a fundamentally important characteristic.

The rootlets of healthy plants of the swamp blueberry are inhabited

by a symbiotic fungus, of the sort known technically as an endotrophic mycorhiza. There is strong evidence that this fungus acts as a purveyor of nitrogen to the blueberry plant, a highly important function since the formation of nitrates in these soils through the agency of nitrifying bacteria is inhibited by the presence of organic acids.

The experiments appear to warrant the following theory of the method of nutrition of the swamp blueberry: (a) The swamp blueberry grows in peaty soils which contain acid or other substances poisonous to many plants. (b) As a protection against the absorption of amounts of these poisons great enough to prove fatal, this plant, like many other bog and acid-soil plants, is devoid of root hairs and consequently has a restricted capacity for absorbing soil moisture. This low absorptive capacity is correlated with a low rate of transpiration. Many bog shrubs, altho living with an abundant supply of moisture at their roots, have been recognized as showing adaptations for retarded transpiration similar to desert plants. (c) The special danger to which the swamp blueberry is exposed by reason of its low transpiration and its corresponding reduced capacity for absorption is insufficient nutrition. The danger of nitrogen starvation is particularly great since these soils contain very little nitrates. (d) Some bog plants similarly threatened with insufficient nutrition, such as the sundews (Drosera), the bladderworts (Utricularia), the pitcher plants (Sarracenia), and the Venus flytrap (Dionæa), possess means of securing the requisite nitrogen by catching insects and digesting and absorbing their nutritive parts. (e) In the swamp blueberry the required nitrogen is secured in a different way. The plant associates with itself a mycorhizal fungus which is able to assimilate nitrogen from the surrounding organic matter, and perhaps from the atmosphere also, and to convey it into the plant without taking along with it a large amount of the poisonous soil moisture.

Whether this theory of the nutrition of the swamp blueberry is or is not substantiated in all its details by future investigation, it has afforded a useful basis for cultural experimentation. A method of blueberry culture has been worked out under which these plants grow with unexpected luxuriance and there is every prospect that the result will be the establishment of a new agricultural industry, the commercial cultivation of the blueberry. F. V. C.

FORESTRY.—*Properties and uses of Douglas Fir.* McGarvey Cline and J. B. Knapp. Forest Service Bulletin No. 88. Pp. 75, with plates and diagrams. 1911.

Douglas fir is perhaps the most important of American woods. It is manufactured in almost every form known to the sawmill operator and much round and hewed timber is used.

Tests on 8 inch by 16 inch by 16 feet Douglas fir bridge stringers gave an average fiber stress at elastic limit, for all grades, of 4000 pounds per square inch when green, and 4467 pounds per square inch when air-dry; a modulus of rupture of 6000 pounds per square inch when green, and 6327 pounds per square inch when air-dry; and a modulus of elasticity of 1,510,000 pounds per square inch when green, and 1,540,000 pounds per square inch when air-dry. Tests on smaller pieces, free from defects, to determine the properties of green material, gave an average fiber stress at elastic limit of 5500 pounds per square inch; a modulus of rupture of 8400 pounds per square inch; and a modulus of elasticity of 1600 pounds per square inch. Compression parallel to the grain gave a crushing strength at elastic limit of 3600 pounds per square inch. Shearing tests gave an average result of 770 pounds per square inch. Douglas fir varies greatly in quality, the different strength functions ranging in value 50 per cent above and below the averages quoted. Tests show that the so-called red and yellow fir have practically the same strength. The mechanical strength of Douglas fir varies directly with dry weight. Pieces which exhibited the greatest strength show usually a rate of growth beween 12 and 16 rings per radial inch. The presence of knots appreciably decreases the strength of green Douglas fir in compression parallel to grain. In beams, the presence of knots affects most the modulus of rupture. The tendency of specifications for Douglas fir is toward too great severity. Findley Burns.

AGRICULTURE.—*The theory and practice of soil management.* Frank K. Cameron, Bureau of Soils. An address before the Michigan Academy of Science, at Lansing, Michigan, April 5, 1911. To appear in its Proceedings.

The soil possesses individuality, its problems are dynamic rather than static, crop production is a complete function in which all the variables are dependent, and various theoretical considerations which hitherto have not received due attention indicate a greater producing power in our soils than has yet been realized in practice. That high production is desirable in all cases is open to question and involves economic factors that must be considered for particular cases. F. K. C.

AGRICULTURE.—*The use of soils east of the Great Plains region.* MILTON WHITNEY. Bulletin Bureau of Soils, No. 78. Pp. 292, Pl. 1 (map), figs. 16.

This is a comprehensive bulletin, embodying the results of the soil surveys from their inception to January 1, 1910. All the soil types established on or before that date are briefly described and their principal uses stated. The soils are grouped in provinces and in classes, the latter based upon textural similarity, and the natural crop adaptations predicated broadly on this basis. The bulletin is divided into seven principal sections, corresponding with the seven soil provinces, and with each section is given a key to the classification of its soils, showing diagrammatically the origin, processes of formation, and other salient characteristics of the various soil series. A map of the soil provinces of the eastern half of the United States showing the exact location of the soil survey areas so far completed accompanies the volume. M. W.

CONCHOLOGY.—*The west American mollusks of the genus Eumeta.* PAUL BARTSCH. Proceedings U. S. National Museum, **39**: 565–568, figs. 1–3. 1911.

In this paper *Eumeta intercalaris* Carpenter, *bimarginata*, C. B. Adams, and *eucosmia*, the last a new species, are described and figured. P. B.

CONCHOLOGY.—*The recent and fossil mollusks of the genus Diastoma from the west coast of America.* PAUL BARTSCH. Proceedings U. S. National Museum, **39**: 581–584. 1911.

This paper is a monograph of the members of this genus occurring on the west coast of America, all of the known species being described and figured. The following are new: *Diastoma chrysalloidea, oldroydæ* and *stearnsi*. P. B.

CONCHOLOGY.—*The recent and fossil mollusks of the genus Cerithiopsis from the west coast of America.* PAUL BARTSCH. Proceedings U. S. National Museum, **40**: 327, pl. 36–41. 1911.

This is a monograph of the west American members of this genus, containing descriptions of the new sub-genera *Cerithiopsina, Cerithiopsida and Cerithiopsidella.* The following species are described as new: *Cerithiopsis* (*Cerithiopsis*) *fatua, ozys, carpenteri, abreojosensis, berryi, galapagensis, cesta, stejnegeri dina, halia, aurea,* (*Cerithiopsina*) *necropolitana, adamsi,* (*Cerithiopsida*) *diegensis, rowelli,* (*Cerithiopsidella*)

antefilosa, alcima; Cerithiopsis (subgenus?) curtata, fossilis, gloriosa, paramœa, bicolor, arnoldi, magellanica, antemuda, diomedeæ and *montereyensis.* P. B.

ENGINEERING.—*Progress and present status of the good roads movement in the United States.* LOGAN WALLER PAGE, Director, Office of Public Roads. Yearbook of the Department of Agriculture, 1910. 1911.

The subject is discussed under the following titles: "Period of Colonial Existence," "Early National Existence," "From 1860 to 1890," "State Aid," "Present Trend." The author tells of the early need for roads as a means of communication between the various colonial settlements and for the transportation of troops, arms and ammunition in the numerous colonial conflicts. The work was largely accomplished by levying labor taxes, and for two centuries nothing more was attempted than to meet the most pressing exigencies. With the American Revolution, and the following increase and spread of population and development of commerce, road building became of paramount importance. A decided movement for better roads was begun, which was manifested by the construction of toll roads by private capital. Strong sentiment for national roads also grew up, and numerous appropriations from the national treasury were made for the purpose, but national participation ended with the Civil War and the consequent heavy national debt. From this time on little attention was given to road improvement until the closing years of the last century.

The author then discusses the development of State aid sentiment in recent years, and the present trend toward more effective highway legislation and skilled supervision, as well as reforms in methods of construction and maintenance. C. S. REEVE.

ENGINEERING.—*Bitumens and their essential constituents for road construction and maintenance.* PREVOST HUBBARD, Circular 93 of the Office of Public Roads, U. S. Department of Agriculture. 1911.

This publication presents in condensed form a description and discussion of various bituminous road materials, in an attempt to dispel the existing confusion concerning the meaning of certain terms applied to these materials. The definitions are still more or less arbitrary and the circular will therefore be revised from time to time in order to keep it abreast with the latest information obtainable.

Definitions and brief discussions occur under the following titles, which are arranged alphabetically:

Acid sludge, anthracene, artificial asphalt, artificial bitumens, asphalts, asphaltenes, asphaltic petroleums, asphaltic cement, Baumé gravity, benzol, bitumen, bituminous, blown petroleum, carbenes, carbon bisulphide, carbon tetrachloride, coal tar, coke-oven tar, cracked oil, cracking, cut-back products, dead oils, destructive distillation, dehydrated tar, emulsions, fixed carbon, flux, free carbon, gas-house coal tar, gilsonite, grahamite, high-carbon tars, hydrocarbons, low-carbon tars, malthas, malthenes, mineral rubber, naphthas, naphthalene, native bitumens, oil asphalts, oil pitches, oil tars, paraffin naphthas, paraffin petroleum, paraffin scale, paraffine, petrolenes, petroleums, petrolic ethers, pitches, pyrobitumens, pyrogenetic, reduced petroleums or reduced oils, refined tar, residual petroleums or residual oils, residual tars, rock asphalt or bituminous rock, semiasphaltic petroleums, short, tar pitches, tars, water-gas tars. C. S. REEVE.

ENGINEERING.—*Methods for the examination of bituminous road materials.* PREVOST HUBBARD and CHARLES S. REEVE. To be published as Bulletin No. 38 of the Office of Public Roads, U. S. Department of Agriculture.

This bulletin describes methods now in use by the Office of Public Roads for the examination of bituminous road materials. These are given in detail with illustrations of practically all of the necessary apparatus; so that any intelligent person may, with a little practice, and the proper equipments, make the desired tests.

For the purpose of examination, bituminous road materials are classified as follows: (1) Petroleums and petroleum products, including residual petroleums, fluxes, oil asphalts, and fluxed or cut-back oil asphalts. (2) Malthas. (3) Asphalts and other solid native bitumens, and asphaltic cements produced by fluxing same. (4) Tars and tar products. (5) Mixtures of tar with petroleum or asphalt products, bituminous emulsions, and factitious asphalts. (6) Bituminous aggregates, including rock asphalts or bituminous rocks, bituminous concrete and asphalt or other bituminous topping.

A scheme of examination for each of the above classes is then discussed with relation to the particular tests applicable to each class.

An appendix contains an itemized list of the necessary equipment for a small laboratory, metric conversion tables, degrees Baumé and specific gravity, and Centigrade and Fahrenheit degrees comparison tables, concluding with forms for reporting and recording tests. C. S. R.

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Gaston County, N. C. W. E. HEARN, L. L. BRINKLEY and F. P. DRANE. Pp. 33. Map.

Washington County, N. Y. M. E. CARR, G. A. CRABB, V. J. FROST and D. W. HALLOCK. Pp. 52. 2 Maps.

Campbell County, Va. R. A. WINSTON. Pp. 39. Map.

Waushara County, Wis. J. W. NELSON, G. CONREY, A. K. KUHLMAN. Pp. 33. Map.

Coffee County, Ala. L. A. HURST and A. D. CAMERON. Pp. 51. Map.

Scotland Co., N. C. R. B. HARDISON, J. W. NELSON, and D. D LONG, Pp. 32. Map.

Western South Dakota. (Reconnaissance.) G. N. COFFEE. Pp. 80. Map.

Woodland Area, Cal. C. W. MANN, J. F. WARNER, H. L. WESTOVER, and J. E. FERGUSON. Pp. 57. 2 Maps.

Clay County, Miss. E. L. WORTHEN. Pp. 41. Map.

Rice County, Minn. R. T. A. BURKE and L. A. KOLBE. Pp. 39. Map.

Cedar County, Mo. E. B. WATSON and H. F. WILLIAMS. Pp. 34. Map.

Southwestern Pennsylvania. (Reconnaissance.) H. J. WILDER and C. F. SHAW. Pp. 69. Map.

Berks County, Pa. W. J. GEIB, E. L. WORTHEN, F. S. WELSH, J. C. BRITTON and C. R. ZAPPONE, JR. Pp. 47. Map.

HYDROLOGY.—*Surface water supply of the United States, 1909:* Part VII. *Lower Mississippi Basin.* W. B. FREEMAN and R. H. BOLSTER. Water-Supply Paper, U. S. Geological Survey No. 267. Pp. 99, with views. 1911.

Surface water supply of the United States, 1909: Part VIII. *Western Gulf of Mexico.* W. B. FREEMAN and R. H. BOLSTER. Water-Supply Paper, U. S. Geological Survey No. 268. Pp. 107, with views. 1911.

Quality of the water supplies of Kansas. H. N. PARKER. With a preliminary report on *Stream pollution by mine waters in southeastern Kansas.* E. H. S. BAILEY. Water Supply Paper, U. S. Geological Survey No. 273. Pp. 375, with maps. 1911.

STATISTICS.—*Mineral resources of the United States, calendar year 1909.* Part I—*Metals.* Part II—*Nonmetals.* U. S. Geological Survey. 1911.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

At the 243d meeting, at the Cosmos Club, April 12, 1911, the following paper was presented and illustrated by lantern slides:

The physical conditions under which Paleozoic coral reefs were formed. T. WAYLAND VAUGHAN.

As the physical conditions prevalent during the formation of fossil coral reefs cannot be ascertained by direct observation, it is necessary to resort to the process of deduction. Evidence for establishing criteria may be derived from two sources: The first, through the study of the conditions under which modern reefs are formed, and the determination of the factors necessary for the physiologic activity to which large accumulations of calcium carbonate are due; the second, through the investigation of the physical character and the nature of the bedding or stratification of the sediments in which the fossil reefs are embedded. The distribution of reef corals and other organisms that form calcareous reefs were considered with reference to depth of water and intensity of light, temperature, motion of the water, character of bottom, composition of the oceanic salts and the specific gravity of the water. Especial attention was paid to the diminishing strength of light with increase in depth of the sea as limiting the downward extension of reef-forming corals. In this connection attention was called to the fact that at the government wharf at Fort Jefferson, Tortugas, which is supported by iron piles coated with cement, there are many corals on all the peripheral piles while on those in the permanently shaded areas there are none.

The results obtained by Sir John Murray from studying the effects of temperature on the distribution of lime secreting organisms were cited as bearing on the problem under consideration. According to this investigator it appears "that the most favorable conditions are met with in the warm, equable, tropical waters of the ocean, and here as a matter of fact we find the greatest development of corals, and the largest number of lime secreting pelagic organisms. In the polar areas and in the cold water of the deep sea there is, as is well known, a feeble development of all carbonate of lime structures in marine organisms."

The data on conditions under which modern coral reefs are formed were summarized as follows: (a) *depth*, maximum, 25 fathoms; light, strong; (b) *temperature*, annual minimum 68° F., annual mean above 70° F.; (c) *water*, agitated and circulating; (d) *bottom*, firm or rocky, without silty deposits; (e) *composition of the oceanic salts*, as for the oceanic waters as a whole; (f) *specific gravity*, as for the ocean in general, range 1.02405 to 1.02748. Of these conditions shallow water, strong light, high temperature, circulating water, a comparatively clean sea-floor, and a chem-

ical composition of the water insuring a supply of calcium salts for the formation of the skeletons are essential.

The speaker then gave a brief review of both the stratigraphic and geographic distribution of Paleozoic coral reefs, calling attention to the more important constituent genera. The Paleozoic coral reefs begin in the lower Cambrian and extend through the Carboniferous. The same groups of reef-building organisms are represented in both the Paleozoic and Recent seas; in both they have the same facies as regards growth-form; in both, their physiologic activity has resulted in the secretion of large quantities of carbonate of lime from the surrounding sea-water; and in both, submarine banks, known as coral reefs, have resulted. The general similarity of the organisms and the similarity in the result of their physiologic activity, suggest similarity of conditions under which his activity took place.

The nature of the sediments and the character of the stratification of the beds in which occur the Silurian reefs of Gotland and Cedarburg, Wisconsin, and the Devonian reefs of Wisconsin and New York, were reviewed. As the materials of the matrix in which the reefs are embedded are largely fragmental, and as cross bedding and other evidence of shallow water deposition is furnished, the conclusion was reached that these Paleozoic reefs were formed in shallow, agitated, and presumably, therefore, well-lighted, waters.

The conditions under which Paleozoic reefs were formed were summarized as follows:

(a) *Depth*, maximum 25 fathoms; light, strong. (b) *Temperature*, annual minimum not lower than between 60 and 70° F., and probably above 70° F. (c) *Water*, agitated and circulating. (d) *Bottom*, clear or relatively free from deposits of silt. (e) *Composition of the oceanic salts*, probably the same as in the ocean of the present day. (f) *Specific gravity of the oceanic waters*, probably about as in the ocean of today. Certainly the specific gravity was high enough to furnish the large quantities of calcium salts demanded by the reef organisms for the formation of their skeletons.

Bonney says in his appendix to Darwin's *Structure and Distribution of Coral Reefs*, p. 331: "Moreover, the *aporosa* and *madreporaria*, which are now the chief reef-builders, have only become common since the conclusion of Paleozoic ages, so that the largest volume of the geological history of the earth is excluded from consideration, because in the time which it covers the habits of the reef-builders may have been different." The evidence presented by Dr. Vaughan showed in his opinion, that the habitats of reef-building corals have always been similar.

Sir John Murray discussed Dr. Vaughan's paper, paying especial attention to the conditions under which organisms secrete large quantities of calcium carbonate in the ocean. He gave a brief review of the distribution of the coral reefs of the globe, described the origin of coral reef foundations, and outlined the theories of the formation of the various types of coral islands. E. S. BASTIN, *Secretary*.

The program of the 244th meeting, at the Cosmos Club, April 26, 1911, was as follows:

Notes on the geology of the Koyukuk-Kobuk region, Alaska. PHILIP S. SMITH.

There are two main physiographic features (1) a high mountain mass to the north known as the Endicott or Baird Mountains, which has been correlated with the Rocky Mountain system in the States, and (2) irregularly distributed highlands and lowlands to the south, forming what has been called the central plateau province. Roughly speaking, the mountain province lies to the north of the Kobuk, and the central plateau province to the south of that river.

The geology of the Endicott Mountains is complex. Schists, limestones, and intrusives, Paleozoic or older in age, are intruded by granular rocks, both granites and diorites, probably of Mesozoic age. Presumably these mountains owe their main outlines to post-Cretaceous deformation and it is possible that this period of mountain building may have occurred well along in the Tertiary. The mountains have been eroded by glacial as well as fluviatile agencies.

The southern province consists mainly of deformed Cretaceous and older metamorphosed sedimentary rocks, the oldest of which have been intruded by granular igneous rocks. In the lowlands Tertiary (?) lavas have been extruded on the eroded surfaces of the older rocks and here and there extensive deposits of gravel reaching to elevations of 500 to 600 feet above the main drainage lines probably represent deposits formed during the waning of glaciation in the mountain province.

One of the striking features of the region is the irregular arrangement of the drainage. Certain of the larger streams flow transverse to the ranges in rocky gorges. The valleys of these streams have been occupied by glaciers or were the spillways through which glacially impounded drainage was discharged.

A summary of the geologic history is as follows: The earliest recorded event was the laying down of the sedimentary rocks of the Endicott Mountains. These, after consolidation, were deformed and intruded by basic igneous rocks and then intensely folded so that the rocks became crystalline schists.

After deformation, the region appears to have remained above the sea until the laying down of the Mesozoic sediments. Into these rocks and probably into the metamorphic rocks, granitic and dioritic intrusives were injected probably in middle Jurassic time. These intrusions were followed by erosion and by the laying down of Cretaceous sediments. Subsequently these rocks were deformed although there was no accompanying development of schistosity. During this period the major outlines of the present topography were blocked out.

A new system of Quaternary lakes in the central Mississippi Basin. E. W. SHAW.

Many of the low-lying parts of the central Mississippi Basin are underlain by a more or less laminated clay containing locally, especially about

the borders, a little fine sand. This clay, by its character and physiographic expression indicates a great system of extinct lakes hitherto undescribed extending from southern Wisconsin to eastern Kentucky. The clay lies at concordant elevations and occupies an aggregate area of several thousand square miles. The physical character, horizontal attitude of the surface, shore features and fossils show that the material is in large part of lacustrine origin, and it appears that the lakes were formed through the rapid development of valley trains on the Mississippi and Ohio in late glacial time the outwash débris damming the lower ends of tributary valleys. The lake deposit is thus a "valley fill," and ranges in thickness up to 130 feet. In each valley the surface of the fill is practically horizontal but the altitude of the surface varies from valley to valley. The height increases regularly from Cairo up the Mississippi and from the same point up the Ohio. The height and hence the extent of the water in each lake being controlled by the river, fluctuated as the river rose and fell, but the lakes served as reservoirs so that the range between high and low water was not so great as it would otherwise have been. Shore features were generally poorly developed but in places, as near Madisonville, Kentucky, there are unmistakable beach ridges.

Discussion of the Cretaceous and Tertiary floras of Alaska. ARTHUR HOLLICK.

About 200 separate collections of fossil plants from Alaska were subjected to critical examination. The localities represented range from Herendeen Bay near the end of Alaska Peninsula, along the coast line to Prince of Wales Island, and through the interior down the Yukon Valley from Eagle to the vicinity of Kaltag, besides several scattered localities in the Tanana region.

Three and possibly four, more or less well-defined floral horizons are represented, with a stratigraphic range extending from the lower part of the middle Cretaceous to the upper Eocene—two in Cretaceous and one, or possibly two, in the Tertiary.

Exact correlation of the floras is difficult for the reason that certain associations of diverse elements occur together in some of the collections which were not known elsewhere in any known, or described, floras. Apparently in Alaska many old types persisted long after they had become extinct in other parts of North America and Europe. Cycads of the genera *Zamites*, *Pterophyllum*, and *Podozamites* are found associated with upper Cretaceous and lower Tertiary angiosperms. The logical assumption would seem to be that the older and more primitive types of vegetation, represented by the cycads, had persisted into more recent times, rather than that the highly developed types, represented by the angiosperm genera, had begun far back in the early part of the Cretaceous. It is evident that the Cretaceous and Tertiary floras of Alaska were as distinct from the equivalent Cretaceous and Tertiary floras of the rest of the North American continent as the living floras of the Pacific Coast are from those of the interior.

The paper was illustrated by a map of Alaska and a chart showing the correlation of the floras. E. S. BASTIN, *Secretary.*